Aneutronic Fusion Spacecraft Architecture

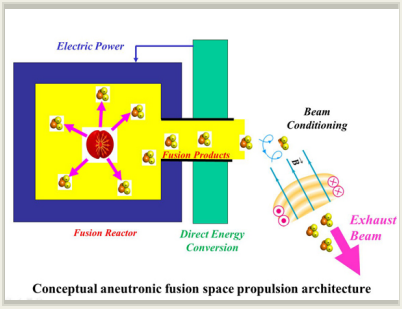
Completed Technology Project (2011 - 2012)

Project Introduction

Description: provide framework to realize fusion propulsion for long-range space travel; analyze "hybrid" schemes with a solar or fission primary energy source along with a sub-critical fusion reactor used as a plasma space propulsion system Objective: conduct a feasibility study for a novel, fusion-powered, space propulsion architecture that can ultimately change drastically the potential for human and robotic space exploration. The object of this proposal is to conduct a feasibility study for a novel, fusion-powered, space propulsion architecture that can ultimately change drastically the potential for human and robotic space exploration. The proposed design is based on neutron-free nuclear fusion as the primary energy source. An innovative beam conditioning/nozzle concept enables useful propulsive thrust directly from the fusion products, while some fraction of the energy is extracted via direct conversion into electricity for use in the reactor and spacecraft systems. This study focuses on providing the framework required to make fusion propulsion an appealing proposition for long-range space travel (by integrating the power generation and propulsion systems) rather than on the development of a specific fusion reactor concept. However, the scope of this study is not constrained by the immediate availability of fusion energy since it also analyzes "hybrid" schemes with a solar or fission primary energy source along with a sub-critical fusion reactor used as a plasma space propulsion system.

Anticipated Benefits

The object of this proposal is to conduct a feasibility study for a novel, fusion-powered, space propulsion architecture that can ultimately change drastically the potential for human and robotic space exploration



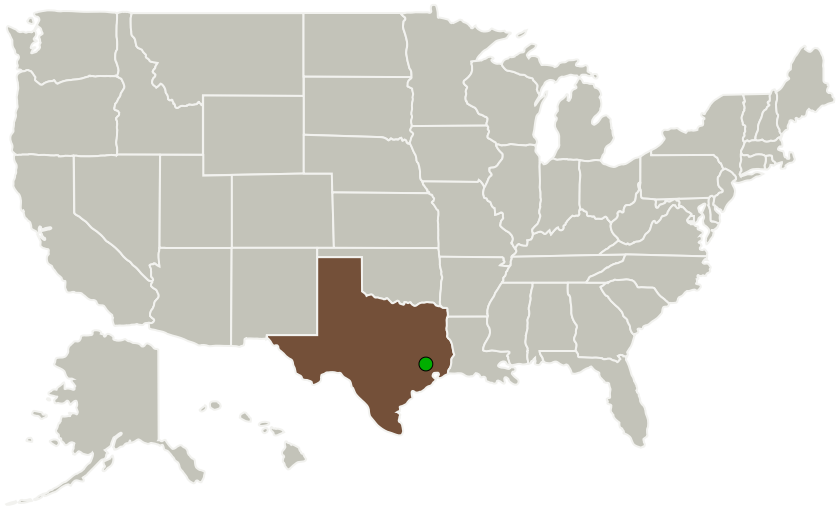
Project Image Aneutronic Fusion Spacecraft Architecture

Table of Contents

Aneutronic Fusion Spacecraft Architecture

Completed Technology Project (2011 - 2012)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
University of Houston-Clear Lake	Lead Organization	Academia	Houston, Texas
Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations
Texas

Project Transitions

September 2011: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

University of Houston-Clear Lake

Responsible Program:

NASA Innovative Advanced Concepts

Project Management

Program Director:

Jason E Derleth

Program Manager:

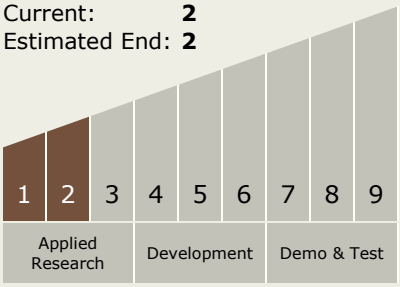
Eric A Eberly

Principal Investigator:

Alfonso Tarditi

Technology Maturity (TRL)

Start: **1**
Current: **2**
Estimated End: **2**



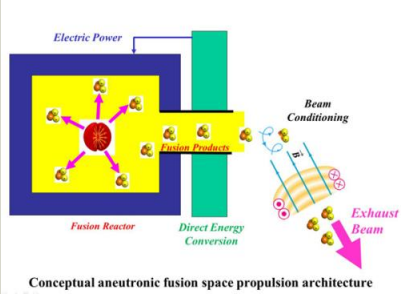
Aneutronic Fusion Spacecraft Architecture

Completed Technology Project (2011 - 2012)

September 2012: Closed out

Closeout Summary: This NIAC Phase I study provided led to several findings t hat provide the foundation for further research leading to a higher TRL: first a q uantitative analysis of the intrinsic limitations of a propulsion system that utilize s aneutronic fusion products directly as the exhaust jet for achieving propulsion was carried on. Then, as a natural continuation, a new beam conditioning proces s for the fusion products was devised to produce an exhaust jet with the require d characteristics (both thrust and specific impulse) for the optimal propulsion pe rformances (in essence, an energy-to-thrust direct conversion). The beam condi tioning process was analyzed in details through modeling and simulation. Anoth er important development was the analysis of the characteristics of the direct en ergy conversion system (Travelling Wave Direct Energy Conversion, beam energ y to electrical energy) was carried on. This system is required for both for electri cal power supply of vehicle systems (including power that maybe re-circulated i nto the fusion core, likely a non-ignited fusion based concept) and for the first st age of the beam conditioning process.

Images



5116.jpg
Project Image Aneutronic Fusion Spacecraft Architecture
(https://techport.nasa.gov/image/102313)

Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.4 Advanced Propulsion
    - TX01.4.4 Other Advanced Propulsion Approaches

Target Destinations

Others Inside the Solar System, Foundational Knowledge